Snow Wetness Estimation from MODIS Images

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Snow wetness is defined as the percentage of free liquid water in the snow pack. It is not as applicable for runoff estimates as snow water equivalent or snow cover area, but it is regarded as a useful indicator for the prediction of snowmelt start and run off. This is very important knowledge for hydropower production as well as flood warnings. MODIS images are very useful for continuous monitoring of the snow quality during the winter and melting season. They are freely available and you can get new images every day.

We have developed algorithms for the calculation of snow cover area (SCA), snow surface temperature (STS), and snow grain size (SGS), using various spectral bands in MODIS images. The snow surface wetness (SSW) is being estimated from these variables.

The approach we propose is to infer wet snow from a combination of measurements of STS and SGS in a time series of observations. The temperature observations give a good indication of where wet snow potentially may be present, but are in themselves not reliable enough to provide very strong evidence of wet snow. However, a strong indication of a wet snow surface is simultaneous observations of a rapid increase of the effective grain size and a snow surface temperature of approximately 0°C.

The algorithms for retrieval of STS and SGS are valid only for 100% snow covered pixels. We, therefore, have to rely on the calculated SCA to be able to select the areas where the snow wetness can be determined.

The SSW product is a map showing the snow quality in three main classes: dry, moist and wet snow. The ‘wet’ snow is most certainly wet, and the ‘moist’ snow is probably wet or close to wet. The ‘dry ‘snow is most probably dry.

Although the methods do not give the correct quantified snow wetness, the product can still be used to calculate the correct timing for onset of the snowmelt process.

SSW maps of South Norway have been made for the last melting seasons. The calculations of the input variables have been evaluated against meteorological data and measurements from field campaigns. The resulting SSW maps seem to be reasonably correct.